National Aeronautics and
Space Administration
**Goddard Space Flight Center**

DIRECTIVE NO. GMI 1710.4B
EFFECTIVE DATE Nov. 15, 1996
EXPIRATION DATE _____

# DIRECTIVE INFORMATION SHEET

**TITLE:** CERTIFICATION AND RECERTIFICATION OF GROUND-BASED PRESSURE VESSELS AND PRESSURIZED SYSTEMS

1. PURPOSE

This revision is needed to: 1) Bring the Center's Pressure Vessels and Pressurized Systems (PV/S) Recertification Program (RECERT) more in line with requirements of the NASA Management Instruction "Safety Program for Pressure Vessels and Pressurized Systems" (NMI 1710.3D), and "NASA Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems" (NHB 1700.6); and 2) Provide clarification to the Applicability, Policy, Requirements, Responsibilities, and other areas of the current GMI 1710.4A for "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems (RECERT)."

2. REVISION

Revision B.

3. CANCELLATION

This revision cancels GMI 1710.4A dated November 28, 1985.

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# MANAGEMENT INSTRUCTION

**TITLE:** CERTIFICATION AND RECERTIFICATION OF GROUND-BASED PRESSURE VESSELS AND PRESSURIZED SYSTEMS

## 1. PURPOSE

This Instruction establishes the policy and requirements for the Goddard Ground-Based Pressure Vessels and Pressurized Systems (PV/S) Recertification Program (RECERT). This Center-funded Program improves personnel safety, and minimizes the potential for damage to, or loss of, hardware and facilities associated with PV/S operations. This Program provides Center organizations with test, inspection, certification and recertification, as well as consultation on design and installation, of PV/S. The policy and requirements established herein meet those mandated by NASA Handbook NHB 1700.6, "Guide for Inservice Inspection of Ground-based Pressure Vessels and Systems," and NASA Management Instruction NMI 1710.3, "Safety Program for Pressure Vessels and Pressurized Systems."

## 2. APPLICABILITY AND EXCLUSIONS

a. Unless specifically noted otherwise, all PV/S referred to by this Instruction are ground-based.

b. The provisions of this Instruction apply to all GSFC organizations.

c. This Instruction is applicable to all PV/S (including vacuum systems) which are used on GSFC properties at Greenbelt, Wallops Flight Facility (WFF), and other areas over which GSFC has jurisdiction (hereinafter referred to as GSFC off-site locations), regardless of user or owner, unless specifically excluded by Table 1 of this Instruction or by the RECERT Manager.

d. The PV/S safety program at off-site contractor installations performing GSFC flight project work shall be evaluated for adequacy by the RECERT Manager at the request of the Flight Project/Division Office and the Contracting Officer. Resulting from the evaluation,

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the RECERT Manager shall recommend any enhancements to the contractor's program and the degree of RECERT Manager oversight needed. These recommendations may be included as contractual requirements if deemed necessary by the Flight Project/Division Office and the Contracting Officer.

e. PV/S brought onto GSFC property for temporary use in support of mission or facilities operations shall be required to comply with the requirements of this Instruction by the initiating Center organization.

f. The Flight Project/Division Office responsible for oversight of any commercial flight projects shall ensure that PV/S brought onto GSFC property are in compliance with the requirements of this Instruction.

g. Tenants and their contract personnel operating in facilities exclusively used for non-GSFC operations and controlled by the tenant under a Center-level Memorandum of Understanding or equivalent document are excluded from this Instruction.

3. POLICY

a. All PV/S shall be formally certified by the RECERT Manager as safe to operate before initial use and shall be recertified periodically after initial certification.

b. All PV/S are subject to RECERT Inservice Inspection (ISI). An ISI Plan shall be developed for each PV/S listing the applicable components to be certified and recertified, the inspection method(s), and the interval between inspections. The initial ISI Plan for each PV/S should follow the guidelines contained in NHB 1700.6.

(1) The ISI Plan for each PV/S at Greenbelt and at WFF shall be developed by the RECERT Manager.

(2) The ISI Plan for each PV/S at GSFC off-site locations shall be developed under the cognizance of the applicable Flight Project/Division Office and forwarded to the RECERT Manager for approval.

4. REQUIREMENTS

a. All PV/S and components, including flexible hoses, shall be designed, fabricated, installed, operated, inspected, and repaired in accordance with this Instruction and applicable codes, standards, guides, and Federal regulations.

b. The emphasis of PV/S certification and recertification shall be prioritized by the RECERT Manager according to the risk or hazard of potential failure using NHB 1700.1(V-1) and RECERT risk assessment procedures. Parameters to be considered in the prioritization process include:

(1) hazardous characteristics of PV/S contents;

(2) stored energy;

(3) mission significance;

(4) proximity of personnel;

(5) system redundancy; and

(6) system condition.

c. Configuration Management

(1) A RECERT configuration management (CM) system at Greenbelt and WFF shall be maintained by the RECERT Manager to ensure that the documentation for each PV/S reflects its field configuration. The RECERT CM system documentation shall include design configuration, PV/S modifications, repairs, replacements, certification status, and ISI schedules.

(2) PV/S CM systems at GSFC off-site locations shall be maintained under the cognizance of the applicable Flight Project/Division Office. Such CM systems shall be reviewed and approved by the RECERT Manager.

d. The impact of all deficiencies, incidents, mishaps, or inability of a PV/S component to meet its ISI acceptance criteria on the certification of the affected PV/S shall be evaluated and documented by the RECERT Manager.

e. PV/S Modifications at Greenbelt and WFF

All modifications to a PV/S void its certification. The following requirements must be met in order for the modified PV/S to be recertified prior to returning it to service.

(1) Proposed modifications shall be submitted by the owner organization to the RECERT Manager for Code compliance review and approval prior to execution.

(2) Upon completion of the modifications, the owner organization shall notify the RECERT Manager so

that necessary tests, inspections, and CM update can be performed for system certification.

f. PV/S Component Repairs and Replacements at Greenbelt and WFF

(1) Repairs and Replacements

All repairs and replacements to a PV/S shall be reviewed and approved by the RECERT Manager prior to the start of work. Preventative and corrective maintenance to pumps and non-overpressure protection valves is exempt from this requirement.

(2) System Recertification

Upon completion of the repairs or replacements, the owner organization shall notify the RECERT Manager so that necessary tests and inspections can be performed for system certification.

g. PV/S Modifications, Repairs, and Replacements at GSFC Off-Site Locations

PV/S modifications, repairs, and replacements at GSFC off-site locations shall be implemented in accordance with the RECERT Manager-approved requirements and CM system provisions.

h. Copies of PV/S test and inspection reports for GSFC off-site locations shall be forwarded to the RECERT Manager by the applicable Flight Project/Division Office for initial certification prior to operation. Subsequent annual submittals will be required for recertification and recordkeeping.

5. CODES, STANDARDS, AND GUIDES FOR GROUND-BASED PV/S

Conformance to the codes, standards, and guides listed below is mandatory. Where reference is made to any of these documents, it is to the latest edition of that document, unless specifically noted otherwise. Regulations promulgated by Federal, State, or Local authorities which are applicable to specific PV/S shall be considered to be included herein. In the event of a conflict between the requirements of a referenced document and the requirements of this Instruction, this Instruction takes precedence, with the exception that the requirements contained in Federal Regulations always take precedence. The RECERT Manager may invoke the requirements of other codes, standards, and guides when specific situations warrant.

a. 29 CFR, Part 1910, "Occupational Safety and Health Standards," OSHA, Department of Labor.

b. 49 CFR, "Transportation," Department of Transportation.

c. NASA Handbook (NHB) 1700.6, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems."

d. NASA Management Instruction (NMI) 1710.3, "Safety Program for Pressure Vessels and Pressurized Systems."

e. NHB 1700.1(V1), "NASA Safety Policy and Requirements Document."

f. American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

g. ANSI/ASME Code for Pressure Piping, B31.

h. ANSI/ASME B19.1, Safety Standard for Air Compressor Systems.

i. ANSI/American Petroleum Institute (API) Codes.

j. ANSI/National Board (NB)-23, National Board Inspection Code, published by the National Board of Boiler and Pressure Vessel Inspectors.

k. ANSI/ASME B40.1, Code for Gauges, Pressure Indicating Dial Type - Elastic Element.

l. American Water Works Association (AWWA), Standard for Inspection and Repairing Steel Tanks, Stand Pipes, Reservoirs and Elevated Tanks for Water Storage.

m. ANSI/AWWA D102-78, Standard for Painting Steel Water Storage Vessels.

n. ANSI/National Fire Protection Association (NFPA) Codes.

o. United States Air Force Technical Manual, T.O. 00-25-223, "Integrated Pressure Systems and Components (Portable and Installed)."

6. DERATING

The feasibility of derating a PV/S shall be determined based upon the results of tests, inspections, and engineering analyses performed by the RECERT Manager or other organization authorized by the RECERT Manager. The new certified operating parameters shall be considered permanent, and the PV/S shall be tagged accordingly. A PV/S may be derated by the RECERT Manager to less severe service conditions in order to:

a. mitigate hazards which exist at the design or currently certified service conditions;

b. extend the useful life of the vessel or system by limiting the service conditions to which the vessel or system is exposed;

c. permit temporary system operation until modifications or repairs are made; and/or

d. permit temporary operation for system verification toward certification.

7. TRANSFER OF PV/S

a. RECERT documentation shall accompany PV/S permanently transferred from GSFC to other locations or users.

b. PV/S and associated documentation transferred to GSFC shall be reviewed for recertification by the RECERT Manager.

8. WAIVERS AND DEVIATIONS

When the technical requirements of applicable Codes, Standards, Guides (with the exception of Federal Regulations), and/or a current NASA or GSFC RECERT policy cannot be met, a waiver/deviation request package shall be prepared by the initiating Flight Project/Division Office. Preparation shall be in accordance with NHB 1700.1 (V1) and RECERT procedures. The waiver/deviation request package shall be reviewed and endorsed by the initiating Flight Project/Division Office and the Safety and Environmental Steering Committee. The endorsed waiver/deviation request package shall then be forwarded to the RECERT Manager for review, approval/disapproval, and other actions as appropriate.

9. TAGGING

Tagging of PV/S shall be as authorized by the RECERT Manager. Each PV/S shall be uniquely identified by a system of tagging and associated documentation indicating the certification status, any special constraints or instructions, and other pertinent information required for safe operation.

10. ADDITIONAL RESPONSIBILITIES

a. Office of the Engineering Directorate, Code 700:

Recommends a candidate RECERT Manager to the Office of the Director for approval.

b. Office of the Suborbital Projects and Operations Directorate, Code 800:

Appoints the Deputy RECERT Manager for WFF with concurrence from the RECERT Manager.

c. RECERT Manager:

The RECERT Manager is responsible for the management and implementation of the Center's PV/S Recertification Program and:

(1) provides technical direction to the Deputy RECERT Managers and the RECERT Support Function;

(2) appoints the Deputy RECERT Manager for Greenbelt;

(3) acts as the primary point-of-contact for all RECERT-related activities;

(4) prepares the annual RECERT budget and requests the required Center funding to implement the Program;

(5) approves inspection, testing, certification, and recertification policies and procedures;

(6) ensures that certification and/or recertification tests and inspections are performed by personnel properly qualified and certified in accordance with applicable codes and standards;

(7) notifies the owner organization and/or Facility Operations Manager (FOM) of deficiencies that require corrective action(s);

(8) reviews/approves waiver/deviation request packages of technical requirements (codes, standards, and guides with the exception of Federal regulations) in accordance with Center authority delegated via this GMI in compliance with NHB 1700.1(V1), "NASA Safety Policy and Requirements Document," 121.e(2);

(9) provides interface with NASA Headquarters and other NASA Centers on matters pertaining to PV/S;

(10) provides a program status report to Center management and NASA Headquarters, as required; and

(11) forwards approved waivers/deviations to NASA Headquarters semi-annually for incorporation into the NASA Safety Information System (NSIS).

d. Deputy RECERT Managers:

The WFF Deputy RECERT Manager represents the RECERT Manager at WFF for day-to-day operations. The Greenbelt Deputy RECERT Manager assists the RECERT Manager in managing and implementing the Program, and represents the RECERT Manager during his/her absence.

e. Divisions and/or Facility Operations Managers:

(1) ensure that PV/S are certified prior to being placed in service;

(2) ensure that the design, fabrication, installation, and testing of new PV/S, and modifications and repairs to existing PV/S are in compliance with applicable codes and standards;

(3) ensure that all applicable documentation listed in Attachment A of this Instruction is furnished to the RECERT Manager for equipment certification prior to operation of new, modified, or repaired PV/S. The supply of such documentation should be made a part of any PV/S procurement;

(4) maintain inventory and control of PV/S components, including flexible hoses;

(5) prepare operating and maintenance procedures;

(6) ensure that any research and development and/or test and evaluation activities conducted within or in association with a PV/S will not adversely impact the structural integrity or safety of the PV/S;

(7) provide availability of PV/S for the scheduled RECERT ISI required to maintain PV/S certification;

(8) notify the RECERT Manager immediately of all deficiencies, incidents, and mishaps involving PV/S;

(9) correct all PV/S deficiencies identified by RECERT ISI. Implement scheduled corrective actions as approved by the RECERT Manager; and

(10) provide for, and ensure that all operators of high pressure systems (>150 psi) are trained and certified.

f. Safety, Environmental, and Security Office:

(1) reviews the RECERT Program for compliance with OSHA and NMI 1710.3; and

(2) monitors the institutional safety requirements of this Instruction.

11. INTERPRETATIONS, CHANGES, AND REVISIONS

Questions on interpretations and recommendations for changes or revisions to this Instruction are welcomed and should be forwarded in writing to the RECERT Manager, Code 750, for appropriate actions.

12. AVAILABILITY

Copies of this Instruction may be obtained from Code 239.

Joseph H. Rothenberg
Director

TABLE 1

ITEMS EXCLUDED FROM GSFC
GROUND-BASED PV/S RECERT PROGRAM

The following types of PV/S are excluded from the GSFC RECERT Program due to their inherently low energy, their national record of operation without serious incident, or because they are subjected to periodic tests and inspections in accordance with requirements other than those contained in the RECERT Program, e.g., GMI 1700.3, "Systems Safety for Flight Orbital Projects," or other applicable documents.

a. Flight-weight pressure vessels and systems.
b. Medium weight pressure vessels and systems.
c. Flight project ground support equipment (GSE): purge carts, engineering test units (ETU's), payload environmental transport systems (PETS), other flight project-specific R&D-type PV/S, etc.
d. Fired pressure vessels (power boilers, heating boilers).
e. Commercially manufactured heating, ventilating, and air conditioning (HVAC) systems, and refrigeration systems (refrigerators and freezers) used expressly for their intended purpose.
f. Fire protection systems including:
   (1) Portable fire extinguishers;
   (2) Standpipe and hose systems;
   (3) Automatic sprinkler systems;
   (4) Fixed dry chemical extinguishing systems;
   (5) $CO_2$ extinguishing systems; and
   (6) Halogenated extinguishing agent systems.
g. Breathing air systems.
h. Contractor PV/S used on-site which are exclusively associated with facility repair, maintenance, modification, or construction activities.

Items excluded from the RECERT Program may be reviewed and evaluated for compliance with test, inspection, and certification requirements of applicable codes and standards by the RECERT Manager at the specific request and funding by the item owner organization.

## DOCUMENTATION REQUIREMENTS FOR NEW GROUND-BASED PRESSURE VESSELS AND PRESSURIZED SYSTEMS

The following documentation shall be provided to the RECERT Manager by the user organization as part of the documentation required for certification prior to placing the system or component in service.

1. Manufacturer's Drawings - Either the certified shop fabrication drawings or as-built drawings for components such as pressure vessels, vacuum vessels, wind tunnels, piping, and expansion joints. The drawings should contain the following:

   a. Manufacturer's name;
   b. Date of manufacture;
   c. Identification of component;
   d. Configuration;
   e. Dimensions and details of construction;
   f. Design and operating conditions;
   g. Design code or design basis;
   h. Thicknesses;
   i. Corrosion allowance;
   j. Identification of materials and design properties;
   k. Efficiency of joints;
   l. Nondestructive Tests; and
   m. Types of tests (e.g., hydrostatic, pneumatic).

2. For components such as pumps, compressors, valves, gages, and relief devices, the drawings should be the certified outline and cross-sectional drawings showing information such as make, model number, materials of construction, and design and operating data.

3. Design Calculations - Design calculations for components such as pressure vessels, vacuum vessels, wind tunnels, and piping should include pressure, temperature, wind, seismic, deadload, and any other applicable loadings. They should specify the applicable code, standard, or other design basis.

4. Manufacturer's Data Report - Manufacturer's Data Reports are furnished with all components built to the rules of the ASME Boiler and Pressure Vessel Code and are illustrated in the applicable sections of this Code. The equivalent for components such as pumps, compressors, valves, gages, and relief valves are data sheets, performance curves, and shop test reports (e.g., hydrostatic test, performance test, net positive suction head test, mechanical running test, relieving capacity, and calibration test).

5. Mill Test Reports - Mill Test Reports are furnished by the material manufacturer for the material supplier to certify compliance with specifications. They contain information such as material manufacturer, purchaser, material specification, description of material furnished, heat number, chemical and mechanical properties, and results of test. There are instances where these are not necessary (see Par. UG-11 (a) and UG-11 (c) of ASME Boiler and Pressure Vessel Code, Section VIII, Division 1).

6. Welding Procedure and Procedure Qualification Records - Welding procedure and procedure qualification test records are prepared and furnished by the manufacturer. They describe the welding procedure and record the test results obtained in welding procedure and welder performance qualifications and the results of examinations of welding operators. These are illustrated in the ASME Boiler and Pressure Vessel Code, Appendix II, Section IX - Welding Qualifications.

7. Record of Nondestructive Tests - Nondestructive test reports are prepared by the manufacturer. When radiographic examinations are performed, the film usually remains in the possession of the manufacturer (for a period of 5 years in the case of equipment built to the ASME Boiler and Pressure Vessel Code). The minimum requirements for the reports are given in the applicable sections of Section V, Nondestructive Examination, of the ASME Boiler and Pressure Vessel Code.

8. Pressure Test Record - The pressure test record is prepared and furnished by the manufacturer.

9. Record of Post-Weld Heat Treatment - This document is prepared by the company performing the heat treatment (when required) and is furnished by the component manufacturer. It shows rates of heating and cooling, holding temperature, and length of time at holding temperature.

10. Facsimile of Nameplate Stamping - This document is prepared by the manufacturer. It is usually a pencil rubbing of the actual nameplate as stamped.

11. Record of Impact Test - This document is furnished either by the material manufacturer or the component manufacturer. It should contain the applicable specification, test procedure used, and results of all tests.

12. Record of Heat Treatment - This is documentation of material heat treatment and is needed only when such heat treatment is done by, or under the control of, someone other than the material supplier. It will be a supplement to the appropriate Mill Test Report.

# GLOSSARY

The following definitions apply to this Instruction.

1. Certification/Recertification - A process performed by the RECERT Manager which leads to the initial or continuation of certification that a PV/S is safe to operate within specific certification parameters. The process includes PV/S compliance and documentation reviews, tests, inspections, nondestructive testing, and analyses.

2. Certification Parameters - The parameters that characterize a pressure vessel or system for safe operation at the original design conditions or at reduced design conditions. These parameters include: (a) material, (b) wall thickness, (c) maximum allowable working pressure or maximum design pressure, (d) temperature, (e) size and shape of pressure vessel, (f) condition of welds (flaws, penetration, porosity, etc.), (g) overpressure protection set point, and (h) system configuration.

3. Commercial Flight Project - Any non-U.S. Government organization or project not normally subject to GSFC requirements which conducts business or operations in a GSFC facility under a contract, Memorandum of Understanding, or equivalent document.

4. Deviation - A variance that authorizes departure from a particular safety requirement, where the intent of the requirement is being met through alternative means that provide an equal or greater level of safety.

5. Flight-Weight Pressure Vessels - Those pressure vessels which cannot be designed, fabricated, or tested to meet the requirements specified in ANSI/ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 due to their lighter weight necessary to meet space flight use requirements. These pressure vessels have a nominal design factor of safety of less than 2.5 and are designed, fabricated, and operated in accordance with NSS/HP 1740.1, "NASA Aerospace Pressure Vessel Safety Standard," and other governing documents.

6. Ground-Based PV/S - PV/S used for ground operations including pressure vessels, piping, flexible hoses, and components for cryogenic service, compressed gases, hydraulic service, and vacuum service. All PV/S shall be designed, fabricated, installed, and tested in accordance with the codes and standards delineated in Section 5 of this Instruction. Other non-code compliant PV/S may be used for

ground operations if approved by the RECERT Manager based upon acceptable engineering analyses, including risk assessment and safety factor considerations.

7. Inservice Inspection (ISI) - On-going RECERT inspection or test performed on PV/S and components after a system has been certified and put into service. The system may have to be shut down during such inspection.

8. Inservice Inspection Interval - The frequency of RECERT inspection or test for each category of PV/S component. The inspection frequency shall be established by the RECERT Manager to ensure operational safety.

9. Maximum Allowable Working Pressure (MAWP) - The maximum pressure permissible at the top of a vessel in its normal operating position at the coincident operating temperature. It is the least of the values found based on calculations for every element of the vessel using nominal thickness exclusive of any allowances for corrosion or loadings other than pressure, and adjusted for any difference for static head that may exist between the part considered and the top of the vessel.

10. Medium Weight Pressure Vessels - These pressure vessels have a design safety factor within the nominal range of 2.5 to 4.0 on ultimate tensile strength. These vessels may be used for flight operations; ground operations directly associated with flight; or for test purposes where simulation of flight hardware or weight reductions are necessary. Design, fabrication, test, operations, certification, and recertification requirements are contained in NSS/HP 1740.4, "NASA Medium Weight Pressure Vessel Safety Standard," and other governing documents.

11. Modification - Any alteration of a PV/S, including addition or deletion of components, rerouting of components, or replacement of components with those of a different size, type, or manufacturer, is considered to be a modification.

12. Nondestructive Testing (NDT) - The development and application of technical methods to examine materials or components in ways that do not impair future usefulness and serviceability in order to detect, locate, measure and evaluate discontinuities, defects and other imperfections; to assess integrity, properties and composition; and to measure geometrical characteristics.

13. Pressure Systems Engineer - This title is obsolete and replaced by "RECERT Manager."

14. Pressure Systems Manager - This title is established by NASA Headquarters in NMI 1710.3. The GSFC title for this position is the "RECERT Manager."

15. Pressure Vessel - Any vessel used for the storage or handling of gas or liquid under positive pressure greater than 15 psig. Included are components of systems, such as, heat exchanger shells, drying towers, and other shell structures for which the rules of ANSI/ASME Boiler and Pressure Vessel Code (B&PVC), Section VIII, Pressure Vessels, would apply.

16. Pressurized System - An assembly of components designed to contain or direct a fluid (gas and/or liquid). Components include vessels, piping, valves, overpressure protection devices, pumps, expansion joints, flex hoses, gages, etc.

17. RECERT - The NASA Recertification Program for periodic certification and/or recertification of ground-based PV/S outlined in NHB 1700.6, NMI 1710.3, and this Instruction.

18. RECERT Documentation - Files that are maintained for PV/S that include manufacturer's/fabricator's documents, field test data, results of analyses, repair history, system descriptions, records of all waivers/deviations, derating information, and correspondence.

19. RECERT Support Function - Code 750's on-site support services contractor providing engineering, technical, and administrative support to implement the Center's RECERT Program under the technical direction of the RECERT Manager.

20. Recertification - The procedure consisting of appropriate tests, inspections, examinations, analyses, and documentation by which a previously certified vessel or system is qualified by the RECERT Manager to continue or be returned to operation at the designated certification parameters.

21. Recertification Program (RECERT) Manager - The RECERT Manager, appointed by the Center Director, has overall implementation, managerial, certification, and recertification responsibility for the Center's RECERT Program for PV/S and Lifting Devices and Equipment (LDE). (Note: LDE RECERT requirements are covered in GMI 1710.6)

22. Vacuum System - An assembly of components operating under vacuum (that is, less than 0 psig), including vessels, piping, valves, relief devices, pumps, expansion joints, gages, etc.

23. Waiver - An authorized departure from a particular safety requirement contained in NHB 1700.6 and/or NMI 1710.3 where an increased level of risk has been accepted. A risk assessment analysis must be performed and the conclusion must be an "Acceptable Risk."